50th NORTHEAST REGIONAL STOCK ASSESSMENT REVIEW COMMITTEE (SARC-50)

Reviewer Report to the Center for Independent Experts on the Monkfish, Sea Scallops and Pollock Benchmark Stock Assessment Review (SARC 50) held June 1-5, 2010 in Woods Hole, Massachusetts.

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Executive Summary

This document is an independent review of the activities and findings of the 50th Northeast Regional Stock Assessment Review Committee Meeting (SARC 50), held June 1-5, 2010 at the Northeast Fisheries Science Center in Woods Hole Massachusetts. Benchmark assessments for three stocks were reviewed at the meeting: monkfish, sea scallops and pollock. I found that sea scallops and pollock assessments provided a sound basis for management advice, but had reservations about the monkfish assessment. In the end, however, the ToRs were met for all three stocks.

I had some significant concerns with the monkfish assessment. First, the input data seems poor. The survey did not catch many fish, the landings were subject to large errors and assumptions, the catch was not well sampled for many years, and there were serious aging problems which cause large uncertainties in the growth model. Second, the model does not appear to be performing well. The model predicts monkfish increases in the past 7 years or so in both management regions, and there is no indication of the population increasing in the raw survey or length frequency data. My concerns are outlined in this report. All ToRs were met.

The assessment of sea scallops was well done. The data were thoroughly examined and utilized, the model was well explored and tested, and the model predictions corresponded with the data and several independent 'gut checks'. There was a general openness to criticism and suggestions by the Panel and very good follow-up later in the meeting. It was clear that Devora Hart and the assessment team had a very thorough understanding of the data and model. The uncertainty in reference points and the probability in overfishing should be pursued as a primary publication. All ToRs were met.

A new assessment for pollock was presented as part of SARC 50. The previous assessment used An Index Method (AIM) and was rejected by the SCC. The new assessment takes a statistical catch at age approach implemented in the Age Structured Assessment Program (ASAP). Overall, the data and assessment model were thoroughly explored lending confidence to the present model formulation and assessment of Pollock stock status. Two key uncertainties, which should both guide future research and caution management, remain: 1) stock definition, 2) cryptic biomass. The SCC might consider asking for a set of reference points to be defined using a flat-topped selectivity until the existence of a cryptic biomass can be proven. All ToRs were met. As a result of this assessment, there now exists a large discrepancy in the estimated biomass of Pollock in US and Canadian waters (~4 times larger in the US). Given the uncertainty in stock structure and the differences in model assumptions the discrepancy in estimated biomass is not likely to be real. Consequently, I recommend that future research and assessment include Canadian scientists.

Overall, given the high quality of the assessment documents and presentations, it was simply a pleasure to participate in this review. The working groups are to be commended for their efforts in these assessments. The process of reviewing three assessments in one

week negatively impacted the quality of the review, particularly the review of model performance. I do not like to be put in the position of presuming the model has been given close scrutiny earlier. I think the assessment team should be given time to present how the model worked (e.g. basic equations, assumptions, likelihoods) and particular adaptations for their data and stock. Likewise, there needs to be more discussion on model diagnostics and fit. I consider this so important that I would add it as a future term of reference. The process of this meeting did not allow for such detailed review and interaction, and it is my view that all three assessments suffered because of it.

Recommendations

- The assessment team should be given time to present how the model worked (e.g. basic equations, assumptions, likelihoods) and particular adaptations for their data and stock.
- A separate term of reference should be created for model diagnostics and fit.
- In the monkfish assessment, I recommend using only one recruitment index per survey.
- I recommend that monkfish age validation be a research priority.
- I recommend that further review of the monkfish assessment not be done until progress is made in several areas as outlined in section 3.9
- I recommend calculating and monitoring the monkfish sex ratio
- The sea scallop reference points are reasonable given the currently highly productive state of the stock, but should be revised if the population reverts to a less productive state
- I recommended that research be done to determine what caused the recent highly productive regime in sea scallops
- The work presented by the sea scallop assessment team on the uncertainty in reference points and the probability in overfishing should be pursued as a primary publication.
- I recommend designing a cooperative survey to help find and monitor large Pollock
- I recommend that future research and assessment of Pollock include Canadian scientists.

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1.0 Background

This document contains my independent reviewer report of review activities and findings for the 50th Northeast Regional Stock Assessment Review Committee Meeting (SARC 48), held June 1-5, 2010 at the Northeast Fisheries Science Center in Woods Hole Massachusetts. Benchmark assessments for three stocks were reviewed at the meeting: monkfish, sea scallops and pollock. Prior to the meeting, the review committee (Appendix 1), were provided with a Statement of Work (Appendix 2), including the Terms of Reference (ToR) for each assessment as well as for the review committee (Panel). Assessment documents and background material (Appendix 3) were provided via a website during the two weeks before the meeting. During the meeting there was a general consensus among the Panel on nearly all of the main discussion points and findings of the committee as outlined in the Summary Report. The Panel concluded that all ToR for each stock assessment were met. I, however, had considerable concerns about the monkfish assessment which are outlined in this report. I have made an effort not to repeat the findings of the panel, which can be found in the SARC 50 report, but rather present my own views about these assessments.

2.0 Individual Reviewer Activities

Prior to the meeting I reviewed the assessment and background documents provided for the review. Although we were expected to conduct an independent review of each assessment, the meeting chair assigned Panel members to act as the lead reviewer for an assessment with the primary responsibility of drafting the review text for that stock for the SARC 50 Summary Report. I was assigned pollock.

I participated in the SARC meeting in Woods Hole, MA, from June 1 to June 5, 2010. The main sessions were open to the public, who contributed constructively to the review, particularly on points of clarification and in discussions about fishery activities.

Assessment leaders from the stock assessment workshops presented the assessment results. The Monkfish assessment was led by Anne Richards, the sea scallop assessment by Devora Hart, and the pollock assessment by Liz Brooks. The Panel met with the working groups (WGs) once after the main presentation to answer further questions and to present additional model runs and analyses. A third meeting with the WGs was primarily to review and edit the Assessment Summary Reports.

Panel members were required to prepare their individual, independent reports after the meeting. As outlined in Appendix 3, these reports should state in the reviewers own words whether each ToR of the Stock Assessment Workshop was completed successfully, should state whether they accepted or rejected the work that they reviewed, and should include an explanation of their decisions (strengths, weaknesses of the analyses, etc.) and recommendations for each ToR. A key determinant of whether a ToR had been met was the extent to which it provided a scientifically credible basis for developing fishery management advice. The following three sections contain my review reports for each of the three assessments.

3.0 Monkfish Assessment Review

Monkfish was assessed using a Statistical Catch at Length (SCALE) model. This model was used in the 2007 assessment and has been updated for this assessment. The model was built by Paul Nitschke and Anne Richards was the assessment lead. Overall, I had some significant concerns with the monkfish assessment. First, the input data seem poor. The survey did not catch many fish, the landings were subject to large errors and assumptions, the catch was not well sampled for many years, and serious aging problems cause large uncertainties in the growth model. Second, the model does not appear to be performing well. The model predicts monkfish increases in the past 7 years or so in both management regions, and there is no indication of the population increasing in the raw survey or length frequency data. I will expand on my concerns below. Both the Panel and I concluded that all ToRs were met.

3.1. Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.

Estimating monkfish landings and length and age composition is difficult. Monkfish is primarily a bycatch fishery in the northern management area and a directed fishery in the southern management area. Landings were poorly sampled prior to 1990. At-sea observers started sampling monkfish in 1989, port-sample measurements were started in 1996, and age data have been collected since 2000. Often only the tail was landed, and a conversion to whole weight was made. Tail lengths were converted to total lengths, and length composition of landings and discards were estimated from fishery observer samples. There was little to no review of these methods at the meeting and I must assume that they have been done well. The ToR was met.

3.2. Report results of 2009 cooperative monkfish survey and describe sources of uncertainty in the data and results.

The cooperative monkfish survey was done in 2001, 2004 and 2009. It provided information on age, growth, maturity and distribution. The survey was incorporated into the model. Future cooperative surveys are encouraged. The ToR was met.

3.3. Characterize other survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, length data, state surveys). Describe the uncertainty in these sources of data.

The NEFSC winter, spring and autumn offshore surveys, the cooperative monkfish survey, NEFSC scallop surveys (SFMA only), Northern Shrimp Technical Committee (NSTC) shrimp surveys (NFMA only), and ME/NH inshore surveys were all used either as indices of abundance or recruitment. Length data were also used from each of these surveys. The usefulness of these surveys as monkfish indices of abundance is limited as the catch rates of monkfish are low. The ToR was met.

In the northern management region, the raw survey data (Fig. A43) indicate that the catch rates have been decreasing for nine years (since 2001), yet the delta distribution and bootstrapped mean numbers per tow show increasing trends over the past three (spring survey) and five (fall survey) years. I suppose this could be possible, but I am always suspicious when there is that much of a change from raw to massaged data. What is going on here? Are the zeros having that much of an effect? Notice that this reversal of a trend after the delta and bootstrapping did not occur in the southern management region. Is this because it has a lower proportion of zeros? Should zeros have that much influence on the trend in the northern management region? In the southern management region, all surveys, except the spring survey, indicate declines over the past seven or eight years and the delta and bootstrapped estimates showed similar trends. There was no discussion about the delta or bootstrapping methods in the assessment report, in the presentation or at the meeting. These methods and data may have been reviewed earlier, but in my view, they did not get adequate review at this meeting. It is also not clear in the assessment report which survey trend was use in the model.

It is roundly recognized that the increased catchability (almost 8x!) of the new survey vessel, the Bigelow, should provide better data for future monkfish assessments.

It is known that monkfish males and females grow to different sizes. I suggest that the sex ratio (using survey and observer data) be calculated, monitored over time, and possibly be incorporated into the model.

It really seems like overkill to use age 1, 2 and 3 as separate recruitment indices. I recommend using only one recruitment index per survey.

What is the correlation between the northern and southern management unit surveys?

3.4. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

The ToR was met, however, I did not think the model performed well, which should be cause for concern. The model predicts monkfish increases in the past 7 years or so in both management regions, and there is no indication of the population increasing in the raw survey or length frequency data. It looks like the decrease in the landings and an assumed productivity is causing these increases. Just because the landings drop does not mean the stock will recover. What is even more worrisome is that the recruitment indices are decreasing since about 2001 or 2002. So it looks like both adult biomass and recruitment are decreasing, yet the model predicts increasing total biomass. Furthermore, the model overestimates the number of large monkfish in the population. So the assessments results appear to be more an artifact of the model than a population increase indicated by the data. The heavy weighting given to the catch data is partly driving this result. My concerns were voiced at the meeting and after some discussion the Panel decided to accept the model and its assessment results. Not having an alternative assessment to 'fall back on' was part of the reason for accepting this assessment. Obviously, this is not good reason to accept an assessment, but rather a reason not to reject it.

An M=0.3 seems far too high for such a large-bodied predatory fish. In this situation, and several others, the assessment team felt constrained by earlier decisions by working groups. I certainly would not take an earlier working group decisions lightly, but I would not acquiesce either. If the assessment team believes strongly that it should be another value, then they should present a case for it in the review, which should include a sensitivity run with M=0.2. The assessment team should take the lead in developing the assessment, not the working group.

The assessment team and reviewers all acknowledged that the ageing data were poor and needed some validation. The Panel report and this report recommend that age validation be a research priority. What I find somewhat disconcerting is that the assessment team did not venture to hypothesize different growth curves based on monkfish life history (eg. size at maturity) and test the sensitivity of the model to these different growth patterns. Then we would begin to understand just how different the model results could be under different growth assumptions.

Should the catch data be weighted that much more than the observer data? I would try a run where the observer data gets more weight. Why use a length-based model if you don't believe the length data (as indicated by your weighting)?

3.5. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

The BRPs were updated from the 2007 assessment using the SCALE model. Overfishing reference points were calculated using an age-based yield per recruit model to update the value of F_{MAX}, assuming M=0.30. B_{TARGET} was defined as the average biomass during the

model period (1980-2009), and $B_{THRESHOLD}$ was the lowest biomass from which the stock increased. The ToR was met, however, I have difficulty believing these estimates when the model is performing poorly (see ToR 3.4).

3.6. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 5).

The stock status was evaluated as not overfishing and not overfished in either the northern or southern management areas. The same conclusion is reached when using the 2007 BRPs. The ToR was met.

There is a large retrospective pattern, which indicates that the model is not performing well (ToR 3.4), that the reference points could be biased (ToR 3.5), possibily leading to incorrect determination of stock status. However, since the assessment results have been accepted, then ToRs 3.4 and 3.5 are met.

3.7. Evaluate monkfish diet composition data and its implications for population level consumption by monkfish.

The ToR was met. These data and the analysis are important for better understanding of the role of monkfish in the ecosystem and to explain future increases and decreases in the monkfish population.

3.8. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).

a. Provide numerical short-term projections (through 2016). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions to examine important sources of uncertainty in the assessment.

b. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.

c. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

The ToR was met. The assessment team provided projections, but given the concerns above about model performance, I feel they are misleading.

3.9. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

The assessment team met the ToR by listing them and stating whether they have been acted on or not. It is disappointing to see so little progress on critical issues such as aging and growth. In fact, so little was done since the 2007, it is unclear why monkfish was included as a benchmark assessment in this meeting. I strongly recommend that further

review not be done until progress is made in several areas, including the following, excerpted from the 2007 Data-Poor Workshop, Research Recommendations:

Working Group I
(2) Applications of the SCALE model for monkfish assessment should be developed further, including:
a) Explore alternative growth functions (sigmoid etc.) since von Bertalanffy growth does not fit length-at-age data
b) Explore changing weighting on catch in relation to reliability of catch data (more uncertainty in early part of time series)
c) Explore using the same M for males and females up to age 7, and then increasing M for males to account for the lack of males over age 7
d) Bin lengths into 2cm or 5 cm increments in order to eliminate zeros in survey length frequencies

From *Working Group II*
(2) Examine aging further and develop tagging studies to validate M, growth rates and longevity
(4) SCALE model:
a) develop objective methods for weighting input series (e.g. inverse variance weighting)
b) do some runs with combined management areas
(5) examine commercial sampling length modes in more detailed time steps (e.g. quarterly) to see if cohorts can be tracked (to indicate whether there are significant problems with aging).

Because monkfish are dimorphic species, I also recommend calculating and monitoring the sex ratio, whether it is incorporated into the model or not. The utility of SCALE for monkfish assessment depends on modifying and improving it as above.

4.0 Sea Scallop Assessment Review

Seas scallops were assessed using the Catch At Size Analysis (CASA) model. This model was used in 2007 assessment and has been updated for this assessment. The model was built by Larry Jacobson and Devora Hart, and Devora Hart was the assessment lead. Overall, the assessment was well done. The data were thoroughly examined and utilized, the model was well explored and tested, and the model predictions corresponded with the data and several independent 'gut checks'. There was a general openness to criticism and suggestions by the Panel and very good follow-up later in the meeting. It was clear that Devora Hart and the assessment team had a very thorough understanding of the data and model. The uncertainty in reference points and the probability in overfishing should be pursued as a primary publication. All ToRs were met.

4.1. Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.

The ToR was met. Discard and incidental mortality were incorporated into the model as assumed values, and were not independently estimated. The mean size of landed scallops has been increasing, as meat counts are at an all time low. Effort peaked on Georges Bank in the early 1990s, but has since stabilized. Effort has increased dramatically in the Mid-Atlantic since 1980. Landings on Georges Bank are close to the average of the 1980s and 90s. Landings in the Mid-Atlantic are at an all time high. Commercial shell heights data were obtained from port samples (1975-1984), and from at-sea observers (1992-2009).

4.2. Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, length data, etc.). Describe the uncertainty in these sources of data. Document the transition between the survey vessels and their calibration. If other survey data are used in the assessment, describe those data as they relate to the current assessment (Exclude consideration of future survey designs and methods).

The ToR was met. The NEFSC annual scallop dredge survey is undertaken by NEFSC, covering Georges Bank and Mid-Atlantic with a stratified random design. Unlined dredge catches for 1975, 1977 and 1978 and lined dredge catches for 1979 onwards are included in this assessment. SMAST video survey data for scallops were used for 2003 onwards, providing information on both scallop density and shell height frequency. The NEFSC winter bottom trawl survey for 1992-2007 was also used in the analytical assessment model for Mid-Atlantic. The uncertainty was well described, but the uncertainty in the video survey seems far too low. A vessel change occurred in 2007 from the *R/V Albatross IV* to the *R/V Hugh Sharp*. *Analyses* indicated no statistically significant differences in the catch rates of the two vessels. Population shell height/meat weight conversions were based on 2001-2008 research vessel derived parameters.

4.3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

The ToR was met. A Catch At Size Analysis (CASA model; Sullivan et al. 1990), was carefully adapted for use on sea scallops (Jacobson; Assessment Report Appendix B11). It is a length-based model that estimates annual fishing mortality, recruitment and stock biomass from catch and survey data. The fundamental data input are growth increments (as opposed to total length or age) which are used to create a stochastic growth matrix. The model uses the shell height/meat weight relationship, growth and natural mortality to estimate annual fishing mortality, recruitment and stock biomass. This model is particularly well suited to scallop data. Fourteen changes were made to the model since the last assessment in 2007 (see Assessment Report), demonstrating a conscientious development of the model and assessment.

The model fit the data well, although I think it would be easier to evaluate model fit if bubble plots of residuals were used (keeping the plots of the predicted and observed proportions at length, but making them larger and more readable). Overall, the model fit the proportions at length and the survey trends well.

Natural mortality is fixed in the model, but was given some consideration in the Assessment Report and in the meeting. A new value of M=0.12 was estimated from the separation time for articulated shells after death for Georges Bank. A life-history invariant relationship was used to infer M=0.15 for the Mid-Atlantic.

There was a moderate retrospective pattern in the Mid-Atlantic. Fishing mortality estimates were revised upwards over time and biomass estimates were revised downwards. Possible causes were discussed at the meeting, and density dependent mortality of young individuals following high recruitment was one explanation. The conflicting trends between the NEFSC scallop survey and the video survey is another possible explanation.

Confidence in the model results was increased by comparison with several simple data-based estimates. In particular, model fishing mortality estimates were consistent with the Beverton-Holt equilibrium estimator and an empirical exploitation index.

I may have missed it, but it looks like the catch is assumed to be known without error? If so, can this assumption be relaxed? Particularly for earlier years? I was not familiar enough with the inner workings of the model, and I think the review would have been better had the assessment team been given the time to explain the model (e.g. starting conditions, transition matrices, the propagation of error, sensitivity to growth assumptions, likelihood profiles). I don't like to be put in the position of presuming the model has been given close scrutiny earlier. The process of reviewing three assessments in one week does not allow for such detailed review and interaction, and it is my view that all three assessments suffered because of it.

4.4. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

The ToR was met. New BRPs were proposed based on a Stochastic Yield Model (SYM). The SYM was made to correspond as much as possible with the CASA model. Per recruit and stock-recruit parameters were assigned probability distributions reflecting their level of uncertainty. For each iteration, parameters were drawn from their distributions, and then per recruit and yield curves were calculated. The stock-recruit parameters were simulated as correlated log-normals. Further details are in the assessment report. The Panel thought SYM model was interesting, innovative and a sound basis for stochastically defined BRPs which can be used in risk-based management. This work should be pursued as a primary publication.

4.5. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 4).

The ToR was met. If the previous F_{MSY} proxy was used or updated, then one concludes that overfishing is occurring. The population is not overfished if the previous $B_{TRESHOLD}$

or its updated value is used. New BRPs were proposed using SYM, F_{MSY} = 0.38 and B_{MSY} = 125,358 mt. These reference points are reasonable given the currently highly productive state of the stock, but should be revised if the population reverts to a less productive state. Based on SYM model outputs, there is no chance that the stock is currently overfished, but there is just under 50% chance that overfishing is occurring. Current fishing mortality is close to (but fractionally under) F_{MSY}. It is unclear what caused the recent productive regime, and it is recommended that research be pursued in this area. Close monitoring of the fishery, growth and recruitment is necessary to prevent risk to population.

4.6. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).

a. Provide numerical short-term projections (through 2014). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions to examine important sources of uncertainty in the assessment.

b. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.

c. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

The ToR was met. A spatial model was used for projections, the Scallop Area Management Simulator (SAMS). This model has been in use since 1999 and was reviewed in the last assessment in 2007. The stock was divided into 16 areas which each had its own stochastic growth transition matrix derived from the shell increments collected in that area. Mortality and recruitment were also area-specific and were assumed to have a gamma distribution. The model was given very little discussion or review at the meeting. There is no reason to miss-trust the model or its projections, but I have to assume it is performing well.

4.7. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

The ToR was met. A list of previous recommendations was provided and the status of these recommendations was stated in the report. Few recommendations were acted upon, however, this does not greatly concern me as it was evident from the review that the assessment team is doing a good job of providing its own direction as evidenced by the 14 changes to the model since the last assessment in 2007. It seems to me that for such a valuable fishery over such a large area, more support / resources could be allocated to address the research recommendations. In my view, the most important are:

4. Look at the historical patterns of the "whole stock"; how the spatial patterns of scallops and the fishery has changed over time.
10. Age archived scallop shells from the 1980s and 1990s.

I focused on these two because I think understanding long-term trends is an important part of understanding the current productivity and any changes in the future.

5.0 Pollock Assessment Review

A new assessment for Pollock was presented as part of SARC 50. The previous assessment used An Index Method (AIM) and was rejected by the SCC. The new assessment takes a statistical catch-at-age approach implemented in the Age Structured Assessment Program (ASAP) created by Legault and Restrepo (1998) and documented in Legault (2008). Liz Brooks was the assessment lead. Overall, the data and assessment model were thoroughly explored lending confidence to the present formulation and assessment of Pollock stock status. Two key uncertainties, which should both guide future research and caution management, remain: 1) stock definition, 2) cryptic biomass. As a result of this assessment, there now exists a large discrepancy in the estimated biomass of Pollock in US and Canadian waters (~4 times larger in the US), which is likely not a real difference and could pose risk to the stock. Consequently, I recommend that future research and assessment include Canadian scientists.

5.1. Characterize the commercial and recreational catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data, including consideration of stock definition.

The ToR was met. Landings from 1960 to present were presented. Discards were estimated from 1989 to present from at-sea observer data. No discard estimates were made for earlier years. There was some difficulty attributing catch to the stock unit (the US waters of NAFO Divs. 5+6) from the Canadian and US fleets before and after the Hague line was implemented. Two model runs were performed to test the sensitivity of the model to this uncertainty. The first was to double the coefficient of variation (CV) on the total catch prior to 1985. The second was to decrease the catch by 50% in this period. The effect of these runs was to decrease the estimate of the 2009 standing stock biomass by 16% (from 196kt to 164kt) but the overall temporal trends remained the same. The Panel thought this was a useful exercise and should not be cause for further concern. For completeness, it recommends that adjustments be made to the Canada / US transboundary catch prior to 1985 by the next assessment.

I am uncomfortable with the current stock definition. The Pollock population in the northeast US and southwest Canada waters is still poorly defined. Earlier assessments included a larger area and at one point the stock was defined as including Georges Bank, Gulf of Maine, Bay of Fundy and the entire Scotian Shelf (NAFO Divs. 4VWX+5+6). The current assessment has the smallest stock definition and only considers the US waters of Divs. 5 and 6. The rationale for this smaller stock unit was not strongly founded on the biology of Pollock, but rather appears to be related to management considerations. A small stock unit relative to the true population dynamics will cause increased noise in the data, difficulties in model fitting, and increased risk to the resource. The US and Canada have already recognized the transboundary nature of three stocks: cod, haddock

and yellowtail founder, and Pollock is known to move even further than these species. If the resource is to be properly understood and assessed, then I strongly encourage the scientists on both sides of the border to collaborate.

Neilson et al. (2006) concluded that there was a considerable amount of mixing depending on where the fish were tagged. Using data from tagging studies conducted between 1978 and 1985, Neilson et al. (2006) found that 22% of fish tagged on the eastern side of the Bay of Fundy were recaptured in US waters. This level of mixing is even higher than estimates for cod (15% between 4X and 5Z; Hunt 1999), and could pose problems for stock assessment and management. There are several avenues to improve our understanding of Pollock stock structure, for example, otolith chemistry and tagging studies using both old and new technologies.

Rather than choosing a stock definition and working within that definition, a more rigorous assessment would have made comparisons between estimates of spawning stock biomass with different stock definitions. This is a considerable amount of work, but could produce some interesting diagnostics. Are the retrospective patterns similar or different? Why? Is there correspondence between the Canadian and US surveys or are they 'out of phase', indicating movement from one area to another. Are cohorts in the catch-at-age any easier to follow?

It is my view that if the stock is not to be placed at risk, then stock definition needs to better researched in collaboration with Canadian scientists.

5.2. Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, age-length data, etc.). Describe the uncertainty in these sources of data, including consideration of stock definition.

The ToR was met. The data for seven surveys was presented. The assessment relied mostly on the NEFSC spring and fall surveys. The catchability of Pollock in these surveys was low with the fall survey catching more fish than the spring. The new vessel the Bigelow appears to have an even lower catchability, probably in part due to the slightly slower towing speed. A lower catchability of Pollock using the Bigelow would reduce sampling effectiveness and has implications for the NMFS survey time series.

5.3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

The ToR was met. The ASAP model appears to be performing well and fits the data. The principal uncertainties are stock definition (discussed in ToR 5.1) and a 'cryptic biomass', that is, a large segment of the population that is not caught by the survey or the fishery. The cryptic biomass is produced by a dome-shaped selectivity. In this assessment, selectivity was estimated at each age. So one needs to determine, is the decreasing selectivity with age well estimated and what are the possible mechanisms? I took a quick look at the CVs of the selectivity at age for the commercial fishery and they did not seem unreasonable, but I suggest closer examination. Why did the parametric

(double logistic) version not work? How about a double-half normal? Is a parametric selectivity too stiff? If so, what does this tell you about estimating the selectivity at older ages? Are we missing important biology by providing too much flexibility in the selectivity function? Maybe the residuals of a flat-topped or parametric descending limb indicate changes in survival, movement or are a part of cohort pulse. There is a trend to fit more parameters in SCAA type models using AD model builder, and AIC is often used to determine whether the fit has improved, but I caution against emphasizing fit over trying to understand biological process and mechanism. At the meeting, Liz Brooks presented a profile likelihood, which I suggest be added to the assessment report. The profile indicated that a flat-topped selectivity was highly unlikely, but Liz Brooks and the assessment team did not choose the most likely set of parameters, but rather, something close that balanced a broader understanding of the model, data and population. They identified a 'circle of belief', a range of selectivities that are possible (generally within 4 AIC pts) which did not include a flat-topped selectivity. I found this approach to be an interesting balance between a data-driven frequentist approach and including prior information / understanding in the Bayesian approach. I think this is generally a good idea, I would just be more explicit in the assessment report about when and where prior knowledge is guiding and at times constraining the analysis and results.

I am also uncomfortable with the logic that fishery selectivity is domed shaped yet the fishery has been selecting for older individuals over time. Have fishing practices / methods changed that much?

So if the statistics are strongly suggesting a dome-shaped selectivity, we are left in the precarious position of asking: where are the large fish? I strongly feel that the scientists and fisherman have an obligation to find them – to prove they are there. Are they in deep water? Do they out-swim the survey gear? The otter trawl fishery? Do they go to Canada? Where are the spawning areas and how much interchange is there between spawning components? A dedicated tagging program and / or a co-operative fishery survey could help answer this critical question. What is it about the model / data that produces a dome-shaped selectivity. Model simulation could test to see whether a dome-shaped selectivity can be produced by ~20% movement of large fish out of the stock unit. As stock area increases and the % immigration decreases does the selectivity become more flat-topped? Could the dome-shaped selectivity really be a result of an ageing problem? That would be really scary, but fixable. Since we are dealing with a statistical catch at age model, I would make it a priority to have a high level of confidence in the ageing.

It was not clear to me why a VPA was not done to compare with past (pre-AIM) assessments and the current results of the ASAP model. What was the weakness or shortcomings of the VPA to cause the assessment team to switch to AIM? Are those concerns still valid? I will venture to guess that the results of a VPA would come out similar to the ASAP model because they both strongly emphasize the catch at age data. I think this comparison would be as useful as the comparison with the Butterworth and Rademeyer (B&R) SCAA model. Model comparisons teach us a lot about how the model treats the data. It was interesting to see that the B&R model came up with similar results

to the ASAP model when similar assumptions were made. As I recall, even the scales of biomass were similar, although the B&R model estimates had a larger variance.

5.4. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

The ToR was met. The BRPs were completely redefined and were based on the ASAP model results. $F_{40\%}$ was used as a proxy for F_{MSY}. Given that the steepness parameter of the stock – recruitment relationship was not well defined, the time series of long-term recruitment was used in the determination of B_{MSY}. B_{TARGET} was used as the proxy for SSB_{MSY} and was estimated at 91,000 metric tons, with 5th and 95th percentiles 71,000 and 118,000 mt respectively. One half of SSB_{MSY} was proposed for $B_{THRESHOLD}$. These reference points represent a large change in estimated size of the stock and are highly dependent on the dome-shaped selectivities and the presumed existence of a cryptic biomass. The SCC might consider asking for a set of reference points to be defined using a flat-topped selectivity until the existence of a cryptic biomass can be proven.

5.5. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 4).

The ToR was met. One comforting analysis is that the stock status did not change when a flat-topped selectivity was assumed. SSB decreased by a large amount (~half), but the population was not assessed as overfished and overfishing was not occurring. So even if the proposed model with a domed-shaped selectivity is wrong, the current risk to the resource is low. Nonetheless, the table in the Panel's SARC report on risk to the stock depending on model assumptions should be closely evaluated through model simulation.

5.6. Evaluate pollock diet composition data and its implications for population level consumption by pollock.

The ToR was met. This data and analysis is important for better understanding of the role of pollock in the ecosystem and to explain future increases and decreases in the pollock population.

5.7. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).

a. Provide numerical short-term projections (through 2017). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions to examine important sources of uncertainty in the assessment.

b. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.

c. For a range of candidate ABC scenarios, compute probabilities of rebuilding the stock by 2017.

d. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

The ToR was met. Standard methods for groundfish were applied. The projections fish down the population from 196,000mt to 91,000mt at $F_{40\%}$, with landings decreasing from 25,200mt in 2010 to 17,500mt in 2017 with minor fluctuations until equilibrating at 16,200mt. I think this is too aggressive, until more research is done on the cryptic biomass.

5.8. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

The ToR was met. A list of recommendations from a previous working group was provided. In my view, the most important are:

- Selectivity studies
    - Physical selectivity (e.g., multi-mesh gillnet)
    - Behavioral studies (e.g., swimming endurance, escape behavior)
    - Explore geographic and vertical distribution by size and age
    - Tag-recovery at size or age
    - Evaluate information on length-specific selectivity at older ages
- Stock definition – sensitive genetic markers, tagging and otolith chemistry and/ or marking
- Alternative pollock surveys (fixed gear, etc.) –
- Further evaluate quality of age determination of old fish

I also recommend designing a cooperative survey to help find and monitor large Pollock.

6.0 Comments on the Assessment Process

A lot of work was presented and reviewed in the SARC 50. I felt that the lead assessment scientists used their time well, but given the time constraints they were required to rely on previous reviews and working group decisions instead of presenting them at this review. An independent review can not occur if not all critical components are open for discussion and reevaluation. The ToRs were given more or less equal priority as far as time and discussion, and I think the review process would have been better if more time was allocated to model structure, assumptions and diagnostics. While some of the material was presented at the meeting, many critical aspects were buried in appendices. Reviewing one or two stocks in a week would allow the assessment scientists and the review panel more time for a thorough discussion of the model and assessment.

7.0 Acknowledgements

I thank Paul Rago and Jim Weinberg for their hospitality (including a bicycle and dry socks!) and professionalism during the meeting. Thanks to Bob O'Boyle for doing an excellent job chairing the meeting, and keeping us on schedule. I thank the other panel members, Mike Bell, John Wheeler, and Pat Sullivan, for stimulating discussions during the meeting and after hours. I thank Manoj Shivlani for his work coordinating the review and his assistance with travel arrangements. This is no small task and it is greatly appreciated. I thank the assessment teams led by Anne Richards (monkfish), Devora Hart (sea scallops), and Liz Brooks (pollock) for providing clear and thorough assessment documents and presentations at the meeting.

8.0 Appendices

Appendix 1: Review Panel Membership

Appendix 2: CIE Statement of Work

Appendix 3: Bibliography of Materials Provided for Review

Appendix 1: Review Panel Membership.

Review Panel Membership

Member	Primary Affiliation
Bob O'Boyle, chair	Beta Scientific Consulting, Canada
Patrick Sullivan	Cornell University, New York
Mike Bell	Heriot-Watt University, Institute of Petroleum Engineering, Scotland
John Wheeler	Department of Fisheries and Oceans, Canada
Kurtis Trzcinski	Department of Fisheries and Oceans, Canada

Appendix 2: CIE Statement of Work.

Statement of Work

(v. 5 April 2010)

External Independent Peer Review by the Center for Independent Experts

50th Stock Assessment Workshop/ Stock Assessment Review Committee (SAW/SARC)

Monkfish, Sea scallop, and Pollock

Statement of Work (SOW) for CIE Panelists
(including a description of SARC Chairman's duties)

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.com.

Project Description: The purpose of this SARC50 meeting will be to provide an external peer review of benchmark stock assessments for monkfish (also called goosefish, *Lophius americanus*), sea scallop (*Placopecten magellanicus*), and pollock (*Pollachius virens*). Goosefish are piscivorous, and they rest partially buried on soft bottom substrates and attract prey using a modified fin ray that resembles a fishing pole and lure. Sea scallops are relatively large filter-feeding bivalves that rest on the bottom. Pollock are fast swimming, schooling fish. This review determines whether the scientific assessments are adequate to serve as a basis for developing fishery management advice. Results form the scientific basis for fishery management in the northeast region. This meeting satisfies Prioritization criteria 1-3. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**. The SARC Summary Report format is attached as **Annex 4.**

The SARC50 review panel will be composed of three appointed reviewers from the Center of Independent Experts (CIE), a reviewer from the New England Fishery Management Council's Science and Statistics Committee (SSC) and an independent chair from SSC of the New England or Mid-Atlantic Fishery Management Council. The reviewer from the NEFMC SSC is expected to perform duties similar to those described herein for CIE reviewers and on a similar schedule. The SARC panel will write the SARC Summary Report and each CIE and SSC reviewer will write an individual independent review report.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. In general, CIE reviewers for SARC meetings shall have working knowledge and recent experience in the application of modern fishery stock assessment models (e.g., statistical catch-at-age, delay-difference, and traditional VPA). Reviewers should also have experience in evaluating measures of model fit, identification, uncertainty, and forecasting, as well as in development and application of biological reference points. Direct experience with the biology and population dynamics of species on the agenda would be beneficial.

Specifically for the monkfish assessment, reviewers should be familiar with length-based statistical assessment models and methods for experimentally estimating trawl capture efficiency, and survey trawl calibration studies. Familiarity with statistical methods for ageing fish, and monkfish in particular, is desirable.

For the scallop assessment, reviewers should be familiar with methods for assessing invertebrates, especially length-based approaches. Expertise in the implications of spatially distinct harvest patterns for stock dynamics and implications for appropriate harvest rates and biological reference points is essential.

For the pollock assessment, reviewers should be familiar with methods for estimating relative abundance of a schooling fish, statistical catch at age models, and potentially methods for model averaging.

Each CIE reviewer's duties shall not exceed a maximum of 17 days to complete all work tasks of the peer review described herein.

Not covered by the CIE, the SARC chair's duties should not exceed a maximum of 17 days (i.e., several days prior to the meeting for document review; the SARC meeting in Woods Hole; several days following the open meeting for SARC Summary Report preparation).

Location and Date of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled at the Woods Hole Laboratory of

the Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts during June 1-5, 2010.

Charge to SARC panel: The panel is to determine and write down whether each Term of Reference of the SAW (see **Annex 2**) was or was not completed successfully during the SARC meeting. To make this determination, panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. Criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable. Where possible, the chair shall identify or facilitate agreement among the reviewers for each Term of Reference of the SAW.

If the panel rejects any of the current Biological Reference Point (BRP) proxies for B_{MSY} and F_{MSY}, the panel should explain why those particular proxies are not suitable and the panel should recommend suitable alternatives. If such alternatives cannot be identified, then the panel should indicate that the existing BRPs are the best available at this time.

Statement of Tasks:

1. Prior to the meeting

(SARC chair and CIE reviewers)
Review the reports produced by the Working Groups and read background reports.

Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein:

Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in

accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

Pre-review Background Documents: Approximately two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

2. During the Open meeting

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

(SARC chair)
Act as chairperson, where duties include control of the meeting, coordination of presentations and discussion, making sure all Terms of Reference of the SAW are reviewed, control of document flow, and facilitation of discussion. For the assessment, review both the Assessment Report and the draft Assessment Summary Report.

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of their analyses. It is permissible to discuss the stock assessment and to request additional information if it is needed to clarify or correct an existing analysis and if the information can be produced rather quickly.

(SARC CIE reviewers)
For each stock assessment, participate as a peer reviewer in panel discussions on assessment validity, results, recommendations, and conclusions. From a reviewer's point of view, determine whether each Term of Reference of the SAW was completed successfully. Terms of Reference that are completed successfully

are likely to serve as a basis for providing scientific advice to management. If a reviewer considers any existing Biological Reference Point proxy to be inappropriate, the reviewer should try to recommend an alternative, should one exist.

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of their analyses. It is permissible to request additional information if it is needed to clarify or correct an existing analysis and if the information can be produced rather quickly.

3. After the Open meeting

(SARC CIE reviewers)

Each CIE reviewer shall prepare an Independent CIE Report (see **Annex 1**). This report should explain whether each Term of Reference of the SAW was or was not completed successfully during the SARC meeting, using the criteria specified above in the "Charge to SARC panel" statement.

If any existing Biological Reference Points (BRP) or their proxies are considered inappropriate, the Independent CIE Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing BRPs are the best available at this time.

During the meeting, additional questions that were not in the Terms of Reference but that are directly related to the assessments may be raised. Comments on these questions should be included in a separate section at the end of the Independent CIE Report produced by each reviewer.

The Independent CIE Report can also be used to provide greater detail than the SARC Summary Report on specific Terms of Reference or on additional questions raised during the meeting.

(SARC chair)

The SARC chair shall prepare a document summarizing the background of the work to be conducted as part of the SARC process and summarizing whether the process was adequate to complete the Terms of Reference of the SAW. If appropriate, the chair will include suggestions on how to improve the process. This document will constitute the introduction to the SARC Summary Report (see **Annex 4**).

(SARC chair and CIE reviewers)

The SARC Chair and CIE reviewers will prepare the SARC Summary Report. Each CIE reviewer and the chair will discuss whether they hold similar views on each Term of Reference and whether their opinions can be summarized into a

single conclusion for all or only for some of the Terms of Reference of the SAW. For terms where a similar view can be reached, the SARC Summary Report will contain a summary of such opinions. In cases where multiple and/or differing views exist on a given Term of Reference, the SARC Summary Report will note that there is no agreement and will specify - in a summary manner – what the different opinions are and the reason(s) for the difference in opinions.

The chair's objective during this Summary Report development process will be to identify or facilitate the finding of an agreement rather than forcing the panel to reach an agreement. The chair will take the lead in editing and completing this report. The chair may express the chair's opinion on each Term of Reference of the SAW, either as part of the group opinion, or as a separate minority opinion.

The SARC Summary Report (please see **Annex 4** for information on contents) should address whether each Term of Reference of the SAW was completed successfully. For each Term of Reference, this report should state why that Term of Reference was or was not completed successfully. The Report should also include recommendations that might improve future assessments.

If any existing Biological Reference Point (BRP) proxies are considered inappropriate, the SARC Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing BRP proxies are the best available at this time.

The contents of the draft SARC Summary Report will be approved by the CIE reviewers by the end of the SARC Summary Report development process. The SARC chair will complete all final editorial and formatting changes prior to approval of the contents of the draft SARC Summary Report by the CIE reviewers. The SARC chair will then submit the approved SARC Summary Report to the NEFSC contact (i.e., SAW Chairman).

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in **Annex 2**.

Other Tasks – Contribution to SARC Summary Report: Each CIE reviewer will assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. CIE reviewers are not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting in Woods Hole, Massachusetts during June 1-5, 2010, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than 18 June 2010, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in **Annex 1**, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

30 April 2010	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
18 May 2010	NMFS Project Contact will attempt to provide CIE Reviewers the pre-review documents by this date
1-5 June, 2010	Each reviewer participates and conducts an independent peer review during the panel review meeting in Woods Hole, MA
4-5 June 2010	SARC Chair and CIE reviewers work at drafting reports during meeting at Woods Hole, MA, USA
18 June 2010	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
21 June 2010	Draft of SARC Summary Report, reviewed by all CIE reviewers, due to the SARC Chair *
28 June 2010	SARC Chair sends Final SARC Summary Report, approved by CIE reviewers, to NEFSC contact (i.e., SAW Chairman)
2 July 2010	CIE submits CIE independent peer review reports to the COTR
9 July 2010	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

* The SARC Summary Report will not be submitted, reviewed, or approved by the CIE.

The SAW Chairman will assist the SARC chair prior to, during, and after the meeting in ensuring that documents are distributed in a timely fashion.

NEFSC staff and the SAW Chairman will make the final SARC Summary Report available to the public. Staff and the SAW Chairman will also be responsible for production and publication of the collective Working Group papers, which will serve as a SAW Assessment Report.

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the

deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) each CIE report shall completed with the format and content in accordance with **Annex 1**,
(2) each CIE report shall address each ToR as specified in **Annex 2**,
(3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

William Michaels, Contracting Officer's Technical Representative (COTR)
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1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
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Key Personnel:

Dr. James Weinberg, NEFSC Stock Assess. Workshop (SAW) Chair, (NMFS Project Contact)
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Dr. Nancy Thompson, NEFSC Science Director
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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of whether they accept or reject the work that they reviewed, with an explanation of their decision (strengths, weaknesses of the analyses, etc.).

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Findings of whether they accept or reject the work that they reviewed, and an explanation of their decisions (strengths, weaknesses of the analyses, etc.) for each ToR, and Conclusions and Recommendations in accordance with the ToRs. For each assessment reviewed, the report should address whether each Term of Reference of the SAW was completed successfully. For each Term of Reference, the Independent Review Report should state why that Term of Reference was or was not completed successfully. To make this determination, the SARC chair and CIE reviewers should consider whether the work provides a scientifically credible basis for developing fishery management advice.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including a concise summary of whether they accept or reject the work that they reviewed, and explain their decisions (strengths, weaknesses of the analyses, etc.), conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the SARC Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not others read the SARC Summary Report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include as separate appendices as follows:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

ANNEX 2:

Assessment Terms of Reference for SAW/SARC50 (June 2010)

(file vers.: 12/22/09-c)

A. Monkfish

1. Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.

2. Report results of 2009 cooperative monkfish survey and describe sources of uncertainty in the data and results.

3. Characterize other survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, length data, state surveys). Describe the uncertainty in these sources of data.

4. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

5. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

6. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 5).

7. Evaluate monkfish diet composition data and its implications for population level consumption by monkfish.

8. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).
    d. Provide numerical short-term projections (through 2016). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions to examine important sources of uncertainty in the assessment.
    e. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
    f. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

9. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

B. Sea scallop

1. Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.

2. Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, length data, etc.). Describe the uncertainty in these sources of data. Document the transition between the survey vessels and their calibration. If other survey data are used in the assessment, describe those data as they relate to the current assessment (Exclude consideration of future survey designs and methods).

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

4. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

5. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 4).

6. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).
    d. Provide numerical short-term projections (through 2014). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions to examine important sources of uncertainty in the assessment.
    e. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
    f. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

7. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

C. Pollock

1. Characterize the commercial and recreational catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data, including consideration of stock definition.

2. Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, age-length data, etc.). Describe the uncertainty in these sources of data, including consideration of stock definition.

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

4. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

5. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 4).

6. Evaluate pollock diet composition data and its implications for population level consumption by pollock.

7. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).
    e. Provide numerical short-term projections (through 2017). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions to examine important sources of uncertainty in the assessment.
    f. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
    g. For a range of candidate ABC scenarios, compute probabilities of rebuilding the stock by 2017.
    h. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

8. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

Appendix to the SAW TORs:

Clarification of Terms
used in the SAW/SARC Assessment Terms of Reference

(The text below is from DOC National Standard Guidelines, Federal Register, vol. 74, no. 11, January 16, 2009)

On "Acceptable Biological Catch":

Acceptable biological catch (ABC) is a level of a stock or stock complex's annual catch that accounts for the scientific uncertainty in the estimate of [overfishing limit] OFL and any other scientific uncertainty…" *(p. 3208) [In other words, OFL ≥ ABC.]*

ABC for overfished stocks. For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan. *(p. 3209)*

NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. (p. 3180)

ABC refers to a level of ''catch'' that is ''acceptable'' given the ''biological'' characteristics of the stock or stock complex. As such, [optimal yield] OY does not equate with ABC. The specification of OY is required to consider a variety of factors, including social and economic factors, and the protection of marine ecosystems, which are not part of the ABC concept. (p. 3189)

On "Vulnerability":

"Vulnerability. A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce MSY and to recover if the population is depleted, and susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality)." (p. 3205)

Annex 3: Meeting Agenda (Preliminary)

50th Northeast Regional Stock Assessment Workshop (SAW 50)
Stock Assessment Review Committee (SARC) Meeting

June 1-5, 2010

Stephen H. Clark Conference Room – Northeast Fisheries Science Center
Woods Hole, Massachusetts

This is a Preliminary AGENDA (version: 2 Feb 2010)

TOPIC	PRESENTER(S)	SARC LEADER	RAPPORTEUR

Tuesday, June 1

8:45-9 AM
Opening
Welcome — **James Weinberg**, SAW Chairman
Introduction — **TBD**, SARC Chairman
Agenda
Conduct of Meeting

9-11 Assessment Presentation (A. Monkfish)
TBD **TBD** **TBD**

11-11:15 Break

11:15 -Noon SARC Discussion w/ presenters (A. Monkfish)
TBD, SARC Chairman

Noon – 1:15 Lunch

1:15 – 3:30 Assessment Presentation (B. Sea Scallop)
TBD **TBD** **TBD**

3:30-3:45 Break

3:45-5:30 PM SARC Discussion w/ presenters (B. Sea Scallop)
TBD, SARC Chairman

Wednesday, June 2

8:45-10:45 Assessment Presentation (C. Pollock)
TBD **TBD** **TBD**

10:45-11 Break

11 -Noon SARC Discussion w/ presenters (C. Pollock)
TBD, SARC Chairman

Noon – 1:15 Lunch

1:15 – 3:15 Revisit w/ presenters (A. Monkfish)
TBD, SARC Chairman

3:15-3:30 Break

3:30-5:30 PM Revisit w/ presenters (B. Sea Scallop)
TBD, SARC Chairman

Thursday, June 3

8:45-10:45 Revisit w/ presenters (C. Pollock)
TBD, SARC Chairman

10:45 – 11 Break

11 - Noon Review/edit Assessment Summary Report (A. Monkfish)
TBD, SARC Chairman

Noon – 1:15 Lunch
1:15 – 2:30 cont. Review Assessment Summary Report (A. Monkfish)
TBD, SARC Chairman
2:30 – 2:45 Break
3 – 5:30 PM Review/edit Assessment Summary Report (B. Sea Scallop)
TBD, SARC Chairman

Friday, June 4

9 - 11:30 Review/edit Assessment Summary Report (C. Pollock)
TBD, SARC Chairman

11:30 – 1:00 Lunch
1 – 5:30 PM SARC Report writing. (closed meeting)

Saturday, June 5

9:00 – 5:30 PM SARC Report writing. (closed meeting)

*All times are approximate, and may be changed at the discretion of the SARC chair. The meeting is open to the public, except where noted.

ANNEX 4: Contents of SARC Summary Report

1.

The main body of the report shall consist of an introduction prepared by the SARC chair that will include the background, a review of activities and comments on the appropriateness of the process in reaching the goals of the SARC. Following the introduction, for each assessment reviewed, the report should address whether each Term of Reference of the SAW was completed successfully. For each Term of Reference, the SARC Summary Report should state why that Term of Reference was or was not completed successfully.

To make this determination, the SARC chair and CIE reviewers should consider whether the work provides a scientifically credible basis for developing fishery management advice. Scientific criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable. If the CIE reviewers and SARC chair do not reach an agreement on a Term of Reference, the report should explain why. It is permissible to express majority as well as minority opinions.

The report may include recommendations on how to improve future assessments.

2.

If any existing Biological Reference Point (BRP) proxies are considered inappropriate, include recommendations and justification for alternative proxies. If such alternatives cannot be identified, then indicate that the existing BRPs are the best available at this time.

3.

The report shall also include the bibliography of all materials provided during the SAW, and any papers cited in the SARC Summary Report, along with a copy of the CIE Statement of Work.

The report shall also include as a separate appendix the Terms of Reference used for the SAW, including any changes to the Terms of Reference or specific topics/issues directly related to the assessments and requiring Panel advice.